

APPENDIX A

Memorandum of Agreement Between Texas Parks and Wildlife Department and U. S
Army Corps of Engineers.

MEMORANDUM OF AGREEMENT
BETWEEN
TEXAS PARKS AND WILDLIFE DEPARTMENT
AND
U.S. ARMY CORPS OF ENGINEERS

1. PURPOSE

The purpose of this Memorandum of Agreement is to establish the process in which the Fort Worth District, U.S. Army Corps of Engineers (CE) will provide funding to the Texas Parks and Wildlife Department (TPWD) to perform selected studies and provide other services in support of the Cypress Bayou Watershed Management Study. This agreement is entered into pursuant to the authority found in 31 U.S.C. Sec. 1535, Federal Acquisition Regulations (48 C.F.R.) Subpart 17.5, Army Regulation (AR) 37-1, and Engineer Regulation (ER) 1.1.6.

2. SCOPE OF WORK

a. In general, the various types of services to be provided by TPWD under this agreement could include planning support activities, literature reviews, environmental surveys and studies, participation in a public involvement program including public meetings, and coordination with educational institutions, as well as procurement of professional service contracts and management of those services.

b. All work tasked to TPWD will be independently managed by TPWD. TPWD shall furnish appropriate professional services including all necessary labor, support services, materials, tools, instruments, and equipment. The services to be provided may be accomplished using a combination of TPWD personnel, seasonal personnel, and contractors as determined jointly by CE and TPWD. Procurement activities by TPWD will be conducted in accordance with regulations that are applicable to TPWD.

c. CE will provide funding, subject to availability, to TPWD to conduct identified services, coordinate with educational institutions and the public, and provide other support as necessary to successfully complete the Cypress Bayou Basin Watershed Management Study. CE will provide technical and/or environmental assistance when requested by TPWD. CE will review the results of the surveys and studies and will provide comments in a timely fashion. All TPWD services will be fully coordinated with the CE and schedules for product or report submission will conform to CE requirements, but TPWD will have ultimate responsibility for technical quality of services performed by TPWD or their contractors.

d. It is understood by the parties that TPWD services (surveys, studies, and coordination conducted in conjunction with this MOA) will comply with applicable Federal and State environmental laws and regulations (for example, the Endangered Species Act, as amended, etc). All data collected by TPWD, as well as data collected by CE, including data layers for Geographic Information Systems, will be shared between the CE and TPWD. Follow-on study efforts which may be identified by the surveys, studies, and coordination are not included ~~within~~ this agreement. Such additional efforts will require further review and separate authorization and agreement prior to the performance of any additional effort.

e. TPWD agrees that it shall be responsible for all damages arising from the prosecution of any work under this agreement that is due to its negligence and/or the negligence of any agents or contractors that it hires to perform work pursuant to this agreement. Similarly, the United States agrees that it shall be responsible for all damages arising from the prosecution of any work under this agreement that is due to the negligence of the United States.

3. AGENCY COORDINATION AND PROGRAM MANAGEMENT

a. To provide for consistent and effective communication between CE and TPWD, each agency shall appoint a representative to discuss and consider technical issues which may be ~~persued~~ under this MOA. As of the signature date of this MOA, those technical Points of Contact will be Jim Neal for TPWD and Ron Ramirez for CE.

b. Unless otherwise notified in writing, the CE and TPWD Program Manager(s) for ~~financial~~ matters shall be:

Michael F. Jordan, P.E.
U.S. Army Engineer District, Fort Worth
AI-I-N: CESWF-PM-C
P.O. Box 17300
Fort Worth, TX 76102-0300
(8 17) 334-9979

Robert Womack
Federal Grants Coordinator
Texas Parks and Wildlife Department
4200 Smith School Road
Austin, TX 78744
(409) 564-7145

4. PROCEDURE FOR ISSUANCE OF ORDERS

a. Proposal: TPWD will provide to CE a description of all services to be performed, an estimate of cost and ~~time~~ to complete the work, and any costs associated with preparatory meetings, site visits and preparation of the scope of work or the proposal. The proposal shall be in a format determined by TPWD, but shall include a breakdown of disciplines necessary to perform each task, completed by an authorized individual of TPWD (Attachment A).

b. Negotiation: TPWD and CE have negotiated specific project requirements and

estimated cost and schedule for completion. Along with TPWD's proposal are the agreed upon costs and schedule, set forth in Attachment A to this MOA.

c. Issuance: In accordance with this agreement, funds in the amount of \$299,000 are certified to be available under the following Corps of Engineers Appropriation/Accounting Classification: 96X3121 General Investigation S96412, (PT) AA312 21DOHITPWD for Coordination / Public Involvement or AA312 21F0C1TPWD for Fish and Wildlife Planning, Reference Number E3194W\$01. *5* *KV*

d. Without written approval of CE, no new or additional work shall commence. TPWD will notify CE immediately if at any time the negotiated cost for an approved task or project, including claims that may arise under any contract, is anticipated to exceed the agreed and funded amount.

5. PAYMENT

Payment by check will be made by CE to TPWD upon receipt of monthly billings as the work progresses. Payment will be made in accordance with the provisions of the Prompt Payment Act. Billings, with supporting cost documentation, should reference the accounting citation as shown in paragraph 4.c. and should be mailed to the address as shown in paragraph 3.b. Provisions may be made for up-front payment to TPWD for contracts to be awarded based upon review and approval by CE of TPWD's Scope of Work (and control estimate) to be contracted.

6. REPORTS

Required reports have been agreed upon during negotiations of specific tasks and requirements are set forth in Attachment A to the MOA. All reports prepared for public release will be reviewed jointly by CE and TPWD prior to release of findings and all findings will be mutually agreed upon by CE and TPWD.

7. DURATION OF AGREEMENT

This agreement is effective immediately upon the last signature date below and shall continue in effect until modified or revoked by either party upon 30 days written notice.

Joseph G. Graf *4/8/94*

Joseph G. Graf
Colonel
Corps of Engineers
District Engineer
(Date)

Andrew Sansom *4/2/94*

Andrew Sansom.
Executive Director
Texas Parks and Wildlife Department
(Date)

ATTACHMENT A
SCOPE OF WORK/BUDGET
 TPWD **SEGMENT** OF
 CYPRESS BAYOU WATERSHED **MANAGEMENT** STUDY

I. Introduction	*
II. Study Authority and Purpose	*
III. Study Methods	
A. Agency Coordination	*
B. Public Involvement	
Video	\$10,000
Slide Show	2,500
Brochure	5,000
Meeting	18,500
Report Preparation	500
	Subtotal 36,500
C. Literature Review	
Travel	2,000
Copying	750
Literature Search	500
Report Preparation	750
	Subtotal 4,000
D. Geographic Information System	•
E. Specific Studies	
Report Preparation	250
	Subtotal 250
IV. Existing Conditions	
A. General Setting	250
	Subtotal 250
B. Demographics	*
C. Physiography	*
D. Geology	*
E. Soils	*
F. Land Use	•
G. Water Resources	
Availability	*
Quality	*
H. Vegetation	
Community Ecology	
Community Classification	8,000
Literature Review	1,000
Refine Classification	2,000
Ground Truthing	40,000
Vegetation Sampling	25,000
Report Preparation	1,000
	Subtotal 77,000
Species of Special Concern	
Identification of Species	2,000
Status Survsye	25,000
	Subtotal 27,000
I. Fauna	
Vertebrate	
Literature Review	1,000
Sampling/Surveys	72,000

(**Special Emphasis** on headwaters area, neotropical
migrants, waterfowl, and amphibians)

Report Preparation		1,000
	Subtotal	74,000

Invertebrate

Literature Review		1,000
--------------------------	--	-------

Sampling/Surveys		12,500
------------------	--	--------

(**Special Emphasis** on headwaters area, mussels,
and butterflies)

Report Preparation		1,000
--------------------	--	-------

Subtotal		14,500
-----------------	--	--------

Species of Special Concern

Identification of Species		2,000
----------------------------------	--	-------

Status Surveys		25,000
----------------	--	--------

Subtotal		27,000
-----------------	--	--------

J. Cultural Surveys

Archaeology		*
-------------	--	---

History		*
---------	--	---

K. Recreation

TPWD Cost		38,000
-----------	--	--------

Subtotal		30,000
-----------------	--	--------

V. Opportunities and Recommendation8 #

A. Future Public Involvement and Partnership Development

B. Environmental Education Opportunities

C. Habitat Restoration/Protection Opportunities

D. Additional Studies/Opportunities

Future Population and Land Utilization Projections

Water Quality

Natural Resources

Cultural Resources

Recreational Resources

E. Finalize Functional GIS

TPWD costs associated with report preparation
for this section is estimated to be \$500.

Subtotal		500
-----------------	--	-----

VI. Summary of Findings

TOTAL TPWD COSTS FOR STUDY		\$299,000
-----------------------------------	--	------------------

Cypress Bayou Watershed LCPM Schedule

ID	Name	Start	Finish	TPWD \$	Corps \$	Lead	94												1995											
							A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S						
1	Total Study Cost	4/1/94	7/1/95	\$299,000	\$301,000																									
2																														
3	Study Management	4/1/94	6/30/95	\$0	\$41,900	Corps																								
4																														
5	Report Preparation	1/3/95	4/1/95	\$0	\$19,300																									
6	All Input Due	1/3/95	1/3/95	\$0	\$0	Corps																								
7	Prepare Draft Report	1/3/95	2/15/95	\$0	\$10,000	Corps																								
8	Draft Review Meeting	2/22/95	2/22/95	\$0	\$2,400	Corps																								
9	Prepare Draft Final Report	3/1/95	4/1/95	\$0	\$6,900	corps																								
10	Submit Draft Final Report to SWD	4/1/95	4/1/95	\$0	\$0																									
11																														
12	Report Review	4/3/95	7/1/95	\$0	\$0																									
13	SWD Review	4/3/95	5/15/95	\$0	\$0																									
14	Response to SWD Comments	5/15/95	7/1/95	\$0	\$0																									
15	Release of Final Report to Public	7/1/95	7/1/95	\$0	\$0																									
16																														
17	USFWS	4/1/94	1/3/95	\$0	\$40,000	USFWS																								
18																														
19	Introduction	12/1/94	1/3/95	\$0	\$1,000	Corps																								
20																														
21	Study Authority & Purpose	12/1/94	1/3/95	\$0	\$500	Corps																								
22																														
23	Study Methods	4/1/94	4/4/95	\$41,000	\$28,600																									
24	Agency Coordination	4/1/94	4/4/95	\$0	\$8,500	Corps																								
25	Public Involvement	5/1/94	4/1/95	\$36,750	\$9,600																									
26	Info Pack	5/1/94	5/1/94	130,000	\$2,600	TPWD																								
27	Public Meeting	9/1/94	9/1/94	\$1,500	\$3,800	TPWD																								

Cypress Bayou Watershed LCPM Schedule

[illegible]

Cypress Bayou Watershed LCPM Schedule

ID	Name	Start	Finish	TPWD \$	Corps \$	Lead	94	1995																	
							A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	
55	Rare and Unique Species	4/1/94	1/3/95	\$27,000	\$1,000																				
56	ID Species	4/1/94	5/13/94	\$2,000	\$500	TPWD																			
57	Surveys as Needed	5/15/94	12/15/94	\$25,000	\$0	TPWD																			
58	Report Preparation	11/15/94	1/3/95	\$0	\$500	TPWD																			
59	Fish and Wildlife Resources	4/1/94	1/3/95	\$115,500	\$17,500																				
60	Vertebrate Fauna	4/15/94	1/3/95	\$74,000	\$6,500																				
61	Lit Review	4/15/94	6/1/94	\$1,000	\$0	TPWD																			
62	Sampling / Surveys	5/16/94	1/3/95	\$72,000	\$6,000	TPWD																			
63	Report Preparation	11/1/94	1/3/95	\$1,000	\$500	TPWD																			
64	Invertebrate Fauna	4/15/94	1/3/95	\$14,500	\$10,000																				
65	Lit Review	4/15/94	6/1/94	\$1,000	\$0	TPWD																			
66	Sampling / Surveys	8/15/94	12/1/94	\$12,500	\$5,000	TPWD																			
67	Report Preparation	11/1/94	1/3/95	\$1,000	\$5,000	TPWD																			
68	Rare and Unique Species	4/1/94	1/3/95	\$27,000	\$1,000																				
69	ID Species	4/1/94	5/13/94	\$2,000	\$500	TPWD																			
70	Surveys as Needed	5/15/94	12/15/94	\$25,000	\$0	TPWD																			
71	Report Preparation	11/15/94	1/3/95	\$0	\$500	TPWD																			
72	Cultural Resources	5/16/94	12/15/94	\$0	\$30,000																				
73	Archeological	5/16/94	12/15/94	\$0	\$20,000	Corps																			
74	Historical	5/16/94	12/15/94	\$0	\$10,000	Corps																			
75	Recreation	4/1/94	3/1/95	\$38,000	\$37,000																				
76	Literature Review	4/1/94	6/1/94	\$1,000	\$6,000	TPWD																			
77	Existing Conditions	4/1/94	1/3/95	\$3,000	\$7,000	TPWD																			
78	Watershed Needs Survey	5/15/94	8/31/94	\$34,000	\$20,000	All																			
79	Incorporate 107	10/3/94	3/1/95	\$0	\$4,000	Corps																			
80																									
81																									

Cypress Bayou Watershed LCPM Schedule

ID	Name	Start	Finish	TPWD \$	Corps \$	Lead	1994												1995																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																												
							A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																							
82	Opportunities and Recommendations	8/15/94	1/3/95	\$500	\$31,500																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										

APPENDIX B

Survey Point Locations. Big Cypress Bayou Watershed Ecological Reconnaissance, June -
October, 1994.

Survey Point Locations
Big Cypress Bayou Watershed Reconnaissance, June - October 1994

Site No.	N Lat. - W Lon.	USGS Quad. Map	county	Cover Type
1	32490617-93554248	Vivian So.	Caddo Par., LA	Up. Shrub
2	32484896-93520182	Vivian So.	Caddo Par., LA	Old Field
3	33064074-94053269	Ravanna	Cass, TX	Hay Field
4	33062606-94044146	Ravanna	Cass, TX	Willow Oak
5	33071143-94035346	Ravanna	Cass, TX	Plant.
6	33065901-94025323	Ravanna	Cass, TX	Pasture
7	33063915-94021552	Ravanna	Miller, ARK	Marsh
8	3305 1871-94004208	Ravanna	Miller, ARK	Mix Pine-Hdwd.
9	33050301-94010222	Ravanna	Miller, ARK	Up. Shrub
10	33035085-94031203	Ravanna	Miller, ARK	Mix Pine-Hdwd.
11	330338 12-9405 1036	Ravanna	Cass, TX	Hay Field
12	33025188-94073041	Ravanna	Cass, TX	crops
13	33015000-94073218	Ravanna	Cass, TX	Pine Forest
14	33005679-94035007	Ravanna	Cass, TX	Bottom. Forest
15	325628 17-9403 13 83	McLeod	Cass, TX	Up. Shrub
16	3251 1213-94063984	McLeod	Cass, TX	Willow Oak
17	32435422-94042662	Potters Pt.	Marion, TX	Pond
18	32434885-94042984	Potters Pt.	Marion, TX	Old Field
19	32355326-940821 17	Karnack	Harrison, TX	Plant.
20	32340359-94081895	Karnack	Harrison, TX	Bare Ground
21	32430603-94080702	Kamack	Harrison, TX	Pine Forest
22	32412648-94103822	Karnack	Harrison, TX	Mix Pine-Hdwd.
23	32412213-94102632	Karnack	Harrison, TX	Mix Pine-Hdwd.
24	32412996-94102832	Kamack	Harrison, TX	Bottom. Forest
25	32413332-94103461	Kamack	Harrison, TX	Cypress
26	32432818-94094545	Kamack	Marion, TX	Bottom. Forest
27	32435882-94085206	Kamack	Marion, TX	Bottom. Forest
28	32435810-94085962	Karnack	Marion, TX	Bottom. Forest
29	32441375-94090613	Kamack	Marion, TX	Cypress
30	32442030-94092541	Kamack	Marion, TX	Cypress
31	324425 15-94094041	Kamack	Marion, TX	Cypress
32	32435730-94095290	Karnack	Marion, TX	Cypress
33	32464407-94252549	Lassater	Marion, TX	Hay Field
34	32464540-94265010	Lassater	Marion, TX	Up. Shrub
35	32464513-94281200	Lassater	Marion, TX	Pine Forest
36	32502334-94320733	Lassater	Marion, TX	Bare Ground
37	32480402-94330770	Lassater	Marion, TX	Urban etc.

Site No.	N Lat. - W Lon.	USGS Quad. Map	County	Cover Type
38	32493666-94331283	Lassater	Marion, TX	Bottom. Forest
39	32500569-94343439	Lassater	Marion, TX	Up. Shrub
40	32502936-94360413	Lassater	Marion, TX	Bottom. Forest
41	3253 2648-9441 5424	Lone Star	Morris, TX	Mix Pine-Hdwd.
42	32542748-94441996	Lone Star	Camp, TX	Bottom. Forest
43	32542343-94441106	Lone Star	Camp, TX	Pond
44	32571521-94443090	Lone Star	Morris, TX	Hay Field
45	33 022172-94443040	Daingerfield	Morris, TX	Urban etc.
46	33 003890-94414797	Daingerfield	Morris, TX	Mix Pine-Hdwd.
47	33012788-94395865	Daingerfield	Morris, TX	Plant.
48	33023740-94405098	Daingerfield	Morris, TX	Up. Shrub
49	33 03 4243 - 9443 2174	Daingerfield	Morris, TX	Plant.
50	33061833-94412195	Daingerfield	Morris, TX	Flooded Forest
51	33 0558 83-94404994	Daingerfield	Morris, TX	Up. Shrub
52	32541776-94365238	Lone Star	Cass, TX	Old Field
53	32525655-94370815	Lone Star	Cass, TX	Bottom. Forest
54	32503042-94414433	Ore City	Marion, TX	Mix Pine-Hdwd.
55	324643 SO-94390200	Ore City	Marion, TX	Bottom. Shrub
56	324743 01-94394699	Ore City	Marion, TX	Bottom. Forest
57	32491123-94444140	Ore City	Upshur, TX	Mix Pine-Hdwd.
58	32374618-9434357s	Hallsville	Harrison, TX	Bottom. Shrub
59	32331650-94344340	Hallsville	Harrison, TX	Pasture
60	32335062-94344328	Hallsville	Harrison, TX	Mix Pine-Hdwd.
61	32345186-94303539	Hallsville	Harrison, TX	Plant.
62	33070579-94581077	Harvard	Titus, TX	Hay Field
63	33043756-94575635	Harvard	Titus, TX	Bottom. Shrub
64	32580023-94572673	Leesburg	Camp, TX	Crops
65	32542036-95030139	Leesburg	Camp, TX	Hay Field
66	32553068-95034687	Leesburg	Camp, TX	Bottom. Forest
67	32572230-95039700	Leesburg	Camp, TX	Shortleaf Pine-Oak
68	33004027-94583477	Pittsburg	Camp, TX	Pine Forest
69	32581320-95061220	Leesburg	Camp, TX	Plant.
70	32560858-95063604	Leesburg	Camp, TX	Bottom. Forest
71	32550221-95072169	Leesburg	Camp, TX	Shortleaf Pine-Oak
72	32543613-95072016	Leesburg	Camp, TX	Crops
73	32542092-95 105360	Newsome	Wood, TX	Mix Pine-Hdwd.
74	32540570-95141550	Newsome	Wood, TX	Pine Forest
75	32503396-95 113637	Rhonesboro	Wood, TX	Mix Pine-Hdwd.
76	32520669-95201254	Rhonesboro	Wood, TX	Up. Shrub
77	32470090-95165401	Rhonesboro	Wood, TX	Bottom. Forest

Site No.	N Lat. - W Lon.	USGS Quad. Map	County	Cover Type
78	32 46 53 08 - 95 12 37 86	Rhonesboro	Wood, TX	Crops
79	32 54 07 29 - 95 09 52 09	Newsome	Franklin, TX	Bottom. Forest
80	33 07 04 05 - 95 14 05 10	Newsome	Franklin, TX	Up. Shrub
81	33 00 33 72 - 95 18 19 18	Purley	Hopkins, TX	Up. Shrub
82	33 02 08 74 - 95 20 01 58	Purley	Franklin, TX	Pasture
83	33 03 48 16 - 95 17 07 10	Purley	Franklin, TX	Hay Field
84	33 01 02 29 - 95 18 50 18	Purley	Franklin, TX	Bottom. Forest
85	33 00 42 45 - 95 17 38 83	Winnsboro	Franklin, TX	Lake
86	33 02 56 69 - 95 10 21 61	New Hope	Franklin, TX	Hay Field
87	33 04 57 27 - 95 09 20 69	New Hope	Franklin, TX	Pine Forest
88	33 09 15 20 - 95 04 32 16	Winfield	Titus, TX	Hay Field (mine)
89	33 08 35 29 - 95 04 38 49	Winfield	Titus, TX	Bare Ground
90	33 00 42 56 - 94 58 42 51	Pittsburg	Camp, TX	Pine Forest
91	32 54 26 34 - 94 44 33 56	Lone Star	Camp, Tx	Willow Oak
92	32 43 00 48 - 94 02 11 53	Potters Pt.	Caddo Par., LA	Bottom. Forest
93	32 48 24 48 - 94 00 52 19	Treco	Caddo Par., LA	Cypress-Tupelo
94	32 47 44 64 - 93 59 07 72	Vivian So.	Caddo Par., LA	Mix Pine-Hdwd.
95	32 46 10 03 - 93 55 40 32	Vivian So.	Caddo Par., LA	Old Field
96	32 46 09 17 - 93 56 16 21	Vivian So.	Caddo Par., LA	Mix Pine-Hdwd.
97	32 45 48 95 - 93 57 58 22	Vivian So.	Caddo Par., LA	Stream
98	32 38 24 66 - 94 00 26 34	Potters Pt.	Caddo Par., LA	Mix Pine-Hdwd.
99	32 38 22 66 - 94 00 54 75	Potters Pt.	Caddo Par., LA	Mix Pine-Hdwd.
100	32 39 29 80 - 94 02 32 40	Potters Pt.	Caddo Par., LA	Up. Shrub
101	32 39 32 35 - 94 07 21 21	Potters Pt.	Harrison, TX	Bottom. Forest
102	32 39 29 01 - 94 07 27 72	Potters Pt.	Harrison, TX	Willow Oak
103	32 39 32 19 - 94 07 30 45	Potters Pt.	Harrison, TX	Pine Forest
104	32 40 05 74 - 94 07 15 03	Karnack	Harrison, TX	Bottom. Forest
105	32 40 22 00 - 94 09 32 15	Potters Pt.	Harrison, TX	Pine Forest
106	32 55 53 58 - 94 11 37 33	Kildare	Cass, TX	Up. Shrub
107	32 58 54 40 - 94 13 30 88	Kildare	Cass, TX	Bottom. Forest
108	32 58 02 49 - 94 14 22 08	Kildare	Cass, TX	Mix Pine-Hdwd.
109	32 32 20 69 - 94 11 12 90	Scottsville	Harrison, TX	Stream
110	32 59 45 38 - 94 23 04 72	Cunningham Ck	Cass, TX	Stream
111	32 58 24 66 - 94 22 03 11	Cunningham Ck	Cass, TX	Stream
112	33 02 16 95 - 94 07 34 34	Atlanta So.	Cass, TX	Stream
113	32 51 00 96 - 95 07 10 87	Rhonesboro	Wood, TX	Stream
114	32 46 51 09 - 95 08 00 59	Rhonesboro	Upshur, TX	Stream
115	33 01 41 74 - 95 17 28 23	Purley	Franklin, TX	Stream
116	33 01 32 42 - 95 18 59 79	Purley	Hopkins, TX	Stream
117	32 32 09 87 - 94 12 23 38	Scottsville	Harrison, TX	Mix Pine-Hdwd.

Site No.	N Lat. - W Lon.	USGS Quad. Map	county	Cover Type
118	32320852-94122649	Scottsville	Harrison, TX	Mix Pine-Hdwd.
119	32320710-94084975	Scottsville	Harrison, TX	Mix Pine-Hdwd.
120	32340748-94083643	Scottsville	Harrison, TX	Mix Pine-Hdwd.
121	32562693-34111165	Kildare	Cass, TX	Plant.
122	32563099-94111078	Kildare	Cass, TX	Mix Pine-Hdwd.
123	32 52 35 60 - 94 11 11 00	Kildare	Cass, TX	Pond
124	32564345-94111894	Kildare	Cass, TX	Bottom. Forest
125	32564633-94112011	Kildare	Cass, TX	Bottom. Forest
126	32570708-94111154	Kildare	Cass, TX	Up. Hard.
127	33013448-94131891	Atlanta So.	Cass, TX	Mix Pine-Hdwd.
128	33013748-94141194	Atlanta So.	Cass, TX	Mix Pine-Hdwd.
129	33015087-94145868	Linden	Cass, Tx	Bottom. Forest
130	32404192-94541472	Gilmer	Upshur, TX	Old Field
131	32404259-94541720	Gilmer	Upshur, TX	Old Field
132	32404485-94541635	Gilmer	Upshur, TX	Up. Hard.
133	32484121-94561793	Bettie	Upshur, TX	Stream
134	32473977-94530746	Bettie	Upshur, TX	Bare Ground
135	32505953-94503871	Coffeeville	Upshur, TX	Pine Forest
136	32504289-94490577	Coffeeville	Upshur, TX	Hay Field
137	32505658-94485871	Coffeeville	Upshur, TX	Mix Pine-Hdwd.
138	32332467-94365886	Hallsville	Harrison, TX	Old Field
139	32335705-94365489	Longview Hts.	Harrison, TX	Old Field
140	32465838-94434450	Ore City	Upshur, TX	Old Field
141	32444710-94295880	Marshall NW	Marion, TX	Bottom. Forest
142	32444636-94300192	Marshall NW	Marion, TX	Willow Oak
143	32444443-94300278	Marshall NW	Marion, TX	Mix Pine-Hdwd.
144	32451497-94295548	Kellyville	Marion, TX	Lake
145	32452538-94202419	Jefferson	Harrison, TX	Bottom. Forest
146	32460930-94201400	Jefferson	Harrison, TX	Bottom. Forest
147	3248 1103 -94221817	Jefferson	Marion, TX	Up. Shrub
148	33015452-94203867	Linden	Cass, TX	Bottom. Shrub
149	33015333-94203666	Linden	Cass, TX	Bare Ground
150	33033368-94240980	Carterville	Cass, TX	Up. Shrub
151	33023930-94255671	Carterville	Cass, TX	Alder
152	33024559-94260615	Carterville	* Cass, TX	Pine Forest
153	32434074-94095132	Kamack	Marion, TX	Cypress
154	32445297-94093787	Kamack	Marion, TX	Bottom. Shrub
155	32450478-94060735	Potters Pt.	Marion, TX	Cypress
156	32440761-94053422	Kamack	Marion, TX	Bottom. Shrub
157	32430298-94134975	Kamack	Marion, TX	Bottom. Forest

Site No.	N Lat. - w Lon.	USGS Quad. Map	County	Cover Type
158	32445134-94153096	Jefferson	Harrison, TX	Bottom. Forest
159	324531 19-94184244	Jefferson	Marion, TX	Bottom. Forest
160	32 46 21 74 - 94 17 26 67	Jefferson	Marion, TX	Up. Shrub
161	32533772-94191897	Jefferson	Marion, TX	Old Field
162	32 53 27 79 - 94 22 49 23	Lanier	Cass, TX	Old Field
163	32524133-94225046	Lanier	Cass, TX	Old Field
164	32515833-94215363	Jefferson	Marion, TX	Pine Forest

APPENDIX C

Big Cypress Bayou Watershed Satellite Imagery Map of the Big Cypress Bayou Watershed Based on 1994 Ground Truthing. Big Cypress Bayou Watershed Reconnaissance, June - July, 1994.

APPENDIX D

Big Cypress Bayou Watershed Ecological Reconnaissance Field Data Form.

BIG CYPRESS BAYOU WATERSHED RECONNAISSANCE FIELD DATA FORM

SITE NO. _____

DATE: _____

TPWD COVER TYPE: _____

LOCATION: Lat. N _____

Lon. W _____

COUNTY: _____

INVESTIGATOR(S)/ADDRESS: _____

SITE CHARACTERISTICS:

Albedo: Light __ Med. _____ Dark _____

% Land Slope: ____ 0-5 ____ 6 - 15 ____ 16-30 ____ 31-45 ____ >46

% Cover: 0-5 6-25 26-50 51 - 75 76-85 >85

Canopy _____

Midstory _____

Ground _____

Dom./co-dom. Trees: Species, _____

No. Trees/ac. H t . Rng., F t . DBH range, In. _

Tree Species:

DBH

Location Sketch:

SPECIES RICHNESS:	High (3)	Medium (2)	Low (1)
Plant			
Animal	_____	_____	_____

CHARACTERISTIC PLANT SPECIES OBSERVED:

CHARACTERISTIC ANIMAL SPECIES OBSERVED:

EST. HABITAT QUALITY:

	Excl. (5)	Good (4)	Fair (3)	Poor (2)	Very Poor (1)
Entomofauna	—			—	—
Ichthyofauna	—	—	—	—	—
Herpteofauna	—	—	—	—	—
Avifauna			—	—	—
Mammals	—	—	—	—	—

NOTATIONS:

APPENDIX E

Statistical Tests and Testing Rational for Assignment of Wildlife Habitat Value (WHV) and Ecological Quality Rankings (EQR) to Select Cover Types. Big Cypress Bayou Watershed Ecological Reconnaissance, 1994.

STATISTICAL NARRATIVE'

Canopy cover percentages at ground level, mid-story, and canopy levels were collected for 12 Big Cypress Bayou Watershed cover types. Using formulas from Cooperrider (1986), vertical and horizontal diversity indices were calculated for each type. Foliar height diversity (FHD) was derived from a logarithmic function of plant density and Horizontal diversity index (HDI) and is a summation of the variability of plant cover at each of the three sampling heights:

$$(Eq 1) FHD = - \sum (p_i) (\log_e p_i),$$

where p_i = proportion of total percent cover (summed across 3 heights) represented by each individual height (i).

$$(Eq 2) HDI = \sum s_i^2 = [\sum k_i^2 - (\sum k_i)^2 / n] / n - 1.$$

Five ecological measures (i.e., horizontal and vertical diversity, species richness for plants and animals, and a habitat ranking) were used to describe and differentiate differences in the cover types. Preliminary statistical tests were performed on all types, but because of low sampling numbers all but eight types were eliminated from evaluation. Similar values were found for Pastures and for Hay Fields. A t-test was performed on these two sub-types to establish that there was no significant difference ($P \leq 0.42$). Thus, the ecological data for Pastures and Hay Fields were combined into one type.

Because each of the ecological measures assess different phenomena, normality assumptions for parametric tests may be violated. Consequently, raw values for cover type by ecological measures were ranked in ascending order and a Kruskal-Wallis nonparametric test was performed to determine if significant differences exist among types (Table 1). No significant differences were detected by this

(Eq 3) KRUSKAL-WALLIS TEST (H statistic):

$$S^2 = (1/N - 1) [\sum \sum R_{ij}^2 - (N(N+1)^2 / 4)]$$

$$H = 1/S^2 [(\sum R_i^2 / n_i) - (N(N+1)^2 / 4)]$$

*Statistical analyses provided by R.C. Rowan, Ph.D., Dept. of Rangeland Ecology and Management, Texas A&M Univ., College Station.

Table 1. Values of ecological measures for eight Big Cypress Bayou Watershed cover types, the rank order of each type measure, and a Kruskal-Wallis test of differences between types.

Site		Ecological Measures									
		<u>*FHD</u>	<u>R_{ij}</u>	<u>HDI</u>	<u>R_{ij}</u>	<u>SRP</u>	<u>R_{ij}</u>	<u>SRA</u>	<u>R_{ij}</u>	<u>HRK</u>	<u>R_{ij}</u>
Waterbodies		45.90	33	32.20	22	64.00	35	74.00	36	3.72	8
Bottomland Hardwood Forest		43.80	29	16.30	15	115.00	40	59.00	34	3.95	9
Unmanaged Pine-Hardwood Forest		45.50	32	13.00	13	107.00	38	43.00	28	3.54	5
Shrub-dominated uplands		29.40	21	10.40	10	109.00	39	39.00	25	3.64	6
Old Fields		21.20	18	12.10	12	81.00	37	33.00	23	3.65	7
Managed Pine Forests		44.00	31	14.40	14	41.00	26.5	22.00	19.5	3.30	4
Pine Plantations		43.90	30	38.00	24	41.00	26.5	18.00	16.5	2.36	3
Pastures and Hay Fields		10.60	11	0.00	1	18.00	16.5	22.00	19.5	2.09	2

KRUSKAL-WALLIS TEST (H statistic):

$$S^2 = (1/N - 1)[\sum \sum R_{ij}^2 - (N(N + 1)^2 / 4)]$$

$$H = 1/S^2[(\sum R_i^2/n_i) - (N(N + 1)^2 / 4)]$$

$$S^2 = 136.628$$

$$H = 6.772$$

Chi Square critical value ($\chi^2_{0.05, 7}$) = 14.07

Since 6.77 < 14.07, accept null hypothesis and conclude that types are similar.

Subscripts i = rows; j = columns

- FHD = Foliage height diversity (logarithmic proportion of percent cover at 3 heights).
- HDI = Horizontal diversity index (summed variance of percent cover at 3 heights).
- SW = Species richness for plants.
- SRA = Species richness for animals.
- HRK = Average habitat ranking.

A two-way analysis of variance test was performed on the raw data and the F-test was significant at the 0.058 level. A Duncan's mean comparison test was performed to identify which cover types were significantly different from one another (Table 2).

Ecological values for the eight types were ranked within each type and summed across each measure (Table 3). Cover types were arranged in descending order based on this summed value.

To better identify how each of the types relate to one another, a factor analysis was performed on four measures (habitat ranking-HRK-was eliminated from consideration because of obscure loadings on factors). Two factors explained 86% of the variability in the original matrix (Table 4), and they appear to represent Species Richness and Structural Diversity. Cover types were then plotted in two dimensions with Structural Diversity on the x-axis and species richness on the y-axis (see text Figure 2, Page 14).

These tests are based upon the assumption that larger values for an ecological measure denote "better" habitat for the corresponding cover type. The nonparametric test (Kruskal-Wallis) did not detect a significant difference among cover types when using ranked values. The analysis of variance was marginally significant and there may be some concern about violations of normality. More sampling within types and sub-types is needed to strengthen the reliability of these findings. Sampling should include all seasons within one or more **annual** cycles.

Table 2. Two-way analysis of variance performed on eight cover types across five ecological measures and a Duncan's least significant difference between type means.

Source of Variation	SS	df	MS	F	P-value	F-crit
Cover types	5227.97	7	746.8524	2.2656	0.0584	2.3593
Ecological measures	2 1580.639	4	5395.1600	16.3664	5.1E-07	2.71408
Error term	9230.137	28	329.6478			
Total	36038.743	39				

Duncan's Mean Comparison Test:*

Waterbodies	a
Bottomland Hardwood Forests	a
Unmanaged Pine-Hardwood Forests	a
Shrub-dominated Uplands	a
Old Fields	ab
Managed Pine Forests	ab
Pine Plantations	ab
Pastures and Hay Fields	b

*Community types with different letters are significantly different at the 0.05 level.

Table 3. Overall ranking of cover types by summed ranks across each ecological measure.*

Community type	FHD Rank	HDI Rank	SRP Rank	SRA Rank	WHV Rank	SUM
Waterbodies	8.0	7.0	4.0	8.0	7.0	34.0
Bottomland Hardwood Forests	4.0	6.0	8.0	7.0	8.0	33.0
Unmanaged Pine-Hdwd. Forests	7.0	4.0	6.0	6.0	4.0	27.0
Shrub-dominated Uplands	3.0	2.0	7.0	5.0	5.0	22.0
Old Fields	2.0	3.0	5.0	4.0	6.0	20.0
Managed Pine Forests	6.0	5.0	2.5	2.5	3.0	19.0
Pine Plantations	5.0	8.0	2.5	1.0	2.0	18.5
Pasties and Hay Fields	1.0	1.0	1.0	2.5	1.0	6.5

* FHD = foliage height diversity
HDI = horizontal diversity
SRP = plant species richness
SRA = animal species richness
WHV = wildlife habitat value.

Table 4. Correlations between standardized cover type measures, rotated factor loadings (Varimax) for each type measure on two nontrivial factors (eigenvalue > 1), and communalities between a type measure and the two factors.*

	<u>FHD</u>	<u>HDI</u>	<u>SRP</u>	<u>SRA</u>	<u>Factor 1</u>	<u>Factor 2</u>	<u>Comm</u>
FHD	1.0000	0.6095	0.0838	0.4192	0.9102	0.2060	0.8708
HDI	0.6905	1.0000	0.0120	0.1198	0.9171	-0.0366	0.8424
SRP	0.0838	0.0120	1.0000	0.6807	-0.0568	0.9206	0.8506
SRA	0.4192	0.1198	0.6807	1.0000	0.2343	0.9018	0.8682
Eigenvalue					2.03	1.40	
Variance explained by factor					50.73	35.07	
Total variance explained							85.80

FHD = Foliar Height Diversity
HDI = Horizontal Diversity Index
SRP = Species Richness for Plants
SRA = Species Richness for Animals

Factor 1 = Species Richness
Factor 2 = Structural Diversity